KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, OCT. 12, 1883.

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BRITISH ASSOCIATION SCRAPS.

DR. STONE read a paper on the electrical resistance of the human body. He began by observing that the application of this powerful force to the organism in a scientific manner was still in embryo, and that the results had hitherto fallen far below what might be expected. The main difficulty in obtaining this resistance lay, first, in the difficulty of making good contact through the skin of a living man, and, secondly, in the rapid electrolysis which takes place in the tissues when a current passes through them. The resistance of the skin, he thought, had been greatly overstated, and might easily be overcome by very large electrodes saturated with a conducting solution. The electrolysis was checked by alternating contacts and momentary duration of the current. In this way he had obtained very satisfactory results—among others, the interesting physiological observation that a man of 5 ft. 6 in. in height, another of 6 ft. 3 in., and the Hungarian giant, who was 8 ft. high, nearly all gave from the wrist to the ankle a resistance close upon a thousand Ohms, the larger man being decidedly the better conductor. The influence of temperature and of disease was also adverted to, the body apparently following the law of solid conductors, increasing in resistance with heat and becoming a far better conductor when suffering from paralysis than in the condition of health.

DR. STONE also read a paper on some effects of brain disturbance on the handwriting. It was not surprising, he said, that affections of the cerebral hemispheres competent to interfere with the complex co-ordination of speech should also show their influence on the similar act of writing. Essentially both functions were acquirements which by practice had become automatic, and were put forth involuntarily. He said, therefore, that as the defect known as aphasia might occur in different parts of the circuit, so might graphic modifications. Three such cases he described, one of which occurred to himself personally. After sustained mental effort, he fell down in a partial state of insensibility. During three weeks delirium and delusions predominated over physical depression. These were broken, however, by lucid intervals. The leading feature of all his aberrations seemed to have been reduplication. He doubled the number of his sisters, his nurses, and his medical attendants. When he returned to himself and could trust his memory and senses he found two things—first, what he had been accustomed to call aphasia; secondly, that he could not write as he intended. The tendency to reduplication, which was obvious in his delusions, was as clear as need be in his writing, and the trick of including otiose letters in familiar words lasted for some time. It was probably the trace either of mental stammering or of diplographia, depending upon want of synchronism between the two hemispheres of the brain. That such a condition of the ocular muscles occurred in drunkenness was well known.

MR. E. P. CULVERWELL read a paper on the probable explanation of the effect of oil in calming waves in a storm. He said when the surface of the sea had become smooth after a storm it was very common for long rollers to break on a sand-bar. If there were no wind and the sea was glassy, these would not break until quite close to the shore, even though the ordinary theory pointed to their breaking earlier, unless there was a force directed opposite to that of their motion. When exerted on the waves, such a force might be supplied by the wind; but if it rose in any direction the waves broke much sooner. This result was, therefore, due to some secondary effect produced by the wind pressure, and not directly by the pressure itself, and it was to the ripples produced on the surface, which disturbed the wave motion, that the speedy breaking was to be attributed. It was, however, a direct result of the theory that the ripples depended on surface tension for their propagation, and could not exist in large amount on the oiled surface. It was also evident that the hold of the wind on the wave was greatly decreased by the absence of ripples, and thus the oil acted both to prevent the wind having much effect on the surface, and also to modify the motion of the water in the wave.

PROFESSOR STOKES read an important paper by Dr. Huggins on coronal photography without an eclipse. In a paper read before the Royal Society some time back, Dr. Huggins had shown that it was possible by isolating, by means of properly chosen absorbing media, the light of the sun in the violet part of the spectrum to obtain photographs of the sun surrounded by an appearance distinctly coronal in its nature. These researches have been continued, using a reflecting telescope by the late Mr. Lassell, and a film of silver chloride as the sensitive plate, on which the photograph is taken. These plates are sensitive to the violet light only, and therefore it was unnecessary to use absorbing media, which had proved a source of difficulty, to sift the light. Fifty photographs in all were taken and examined afterwards by Mr. Wesley, who made drawings of them for the paper. The details shown agree well with the photographs of the corona made during the late solar eclipse, the agreement being specially marked in two cases, dated April 3 and June 5. The photographs have been seen by the observers sent to Caroline Island to observe the eclipse, and one of these writes that Dr. Huggins's coronas are certainly genuine up to 8′ from the sun's limb. Dr. Ball, who was in the chair, examined some of the plates, and spoke of the interest and importance of this communication.

XUM

A NATURALIST'S YEAR.

THE SHREWS DIE.

By Grant Allen.

On every country footpath in October, if only you care to look for them, you will find here and there, at long intervals, the soft furry dead bodies of the pretty little, unobtrusive, English shrew-mice. So commonly are they to be noticed in such situations, indeed, that the country people have (or had) an ancient superstitious belief to account for the fact; they held that a shrew couldn't run across a public path without immediately and incontinently dying. Doubtless the notion was closely connected with that general idea of the uncanniness of the shrew, which is bound up with the incantations of shrew-ashes and shrew-murrain; as a witch-animal, it couldn't show itself on the open, away from the secresy of night, and darkness, and forest shades, without paying the penalty of extinction to the light of day and the broad sunshine: for shrews, like bats, moles, frogs, and lizards, are held as small deer of ill-omen in old-fashioned folk-lore, doubtless because of their retiring habits, and their indirect connection with graveyards, stone monuments, barrows, mounds, and other recognised haunts of ghosts or fairies. To the sober eye of unimaginative science, however, the number of shrews found dead on roads or highways in autumn is merely an index of the far greater numbers which must be scattered about unobserved among the grass of meadows and the tangled undergrowth of the hedgerows, where especially they love to lurk in little shrinking, domestic colonies. So far as one can judge, the shrew tribe is one of those on which the Malthusian problem is always pressing with annual persistence. Like the natives of India, the shrews, in their crass ignorance of political economy, go on increasing with careless improvidence during all seasons when the food supply is abundant, and then get summarily checked again by a vast famine system the moment it begins to fail or diminish. Every spring each female shrew brings forth a litter of six or seven young, and as these are but little checked by natural enemies, owing to their small size and extreme timidity, they find plenty of food throughout the summer, when beetles, worms, slugs, and petty snails abound everywhere among the fields and thickets. But when autumn comes the food-supply falls short, and then the shrews have to be thinned out pitilessly by the inexorable law of nutural selection. Enough, of course, survive to continue the existence of the species undiminished; and as long as that is the case Nature is perfectly satisfied: "So careful of the type she seems, so careless of the single life."

The type, indeed, is one which naturalists at least would not willingly see perish. Like as the shrews are in external appearance to the smaller rodents—so much so that it is a mere bit of purist scientific affectation to speak of them otherwise than as shrew-mice—they are really insectivores of the purest water, and in no way truly related to the rats and mice. Their close outer similarity depends entirely upon adaptive resemblance; it is one more instance of the common law that plants or animals of very similar habits acquire very similar external shapes, however great their real underlying differences of descent. In other words, the same circumstances which have modified the central rodent form into the little harvest mice and field voles have also modified the central insectivorous form into the shrews and their allies. Now, the great evolutionary interest of the shrews consists in the fact that they are themselves in many ways the most primitive and unspecialised insectivores at present existing. Taking the small insectivorous group as a whole, it is remarkable for the extreme divergence and high specialisation of most of its members: though the entire number of living insectivores is but very few, they yet have to be divided into some ten or twelve distinct families, some of which are marked off from the others by highly developed external modifications. For example, we have within this single group such unlike animals as the hedgehog, with his spiny coat and his habit of rolling himself up into a closely-bristling ball; the underground mole, with his small half-buried eyes, his thick coat of peculiar fur, his strong digging paws, and his long pointed muzzle; the squirrel-like bangsrings of the Malay Archipelago, with their big bushy tails, their arboreal habits, and their active, restless disposition; the pretty little jumping elephant-shrews of South Africa, like kangaroos in miniature, semi-erect on their tall hind legs, and possessed of extremely thin proboscis-like muzzles; and, finally, strangest of all, the big, floundering colugo or galeopithecus—the "flying lemur" of early biologists—with its wide parachute membrane between the limbs and body, and its bat-like trick of gliding lightly through the air from one tree or branch to another. This extraordinary variety of external form within the limits of a single small group like that of the insectivores, almost irresistibly suggests the idea that we have here the last feeble remnants of a once wide-spread and important mammalian order. The great mass of the connecting links have apparently died out, and have left the few existing genera of insectivores either as nocturnal, or subterranean, or aquatic creatures in the great continents, or else as solitary denizens of outlying insular or peninsular regions.

A rapid glance at the present distribution of the principal modern insectivores will show this probability far more clearly than any amount of mere reasoning would do. The colugo, for example, lingers on in the Malay Peninsula, Sumatra, and Borneo,—just the sort of places in which stray members of decadent groups are always found. The bangsrings and their allies are also almost peculiar to the Malayan region. The elephant shrews belong chiefly to South Africa, long a separate insular district, as Mr. Wallace has shown, with a very antiquated local fauna of its own. The hedgehogs, though far more cosmopolitan in their distribution (so far as the old world is concerned) are yet marked as outlying members of a dying family by a large combination of features—they have survived by virtue of their prickly defences, their nocturnal habits, their prowling life, and their burrowing instinct: and one very primitive form of hedgehog—which is, in fact, almost shrew-like in most of its peculiarities, and possesses only the merest rudiments of spines—is confined to the very isolated Malayan region, where it has loitered in the early shape without any modification; while its more hardly-pressed neighbours in the great continents have all been weeded out, unless possessed of very spiny prickles, till now they have assumed the familiar form of the common English hedgehog. Another closely-related family, that of the tanrecs, is all but wholly confined to Madagascar, that fertile nurse of ancient types, elsewhere superseded; the only exceptions are those of two similar little animals—the solenodons, one of which inhabits Haiti, while the other is found nowhere but in the tropical jungles of Cuba. It is a very significant fact that allies of this ancient Mascarene family should turn up thus unexpectedly in the West India Islands. Whenever we find closely allied species thus isolated in two remote and peculiar habitats, with no other of their congeners intervening, we may reasonably conclude that the group to which they belong was once far more widely dispersed over the globe, but that they have gradually been superseded in

the intermediate districts. Still more clear does this conclusion become when the existing habitats are in islands or peninsulas, when the animals themselves are clearly archaic in type, and when the intermediate districts are actually inhabited by more advanced and distantly related animals, like our own hedgehogs. Other isolated insectivorous families are the golden moles, now confined entirely to South Africa, and the potamogale, a peculiar West African river shrew. Our own moles and their kind are even more generally distributed than the hedgehogs, being found in the northern half of both hemispheres, though never spreading south of the equator; and they have clearly been preserved by their subterranean habits, for which they have undergone such marked specialisation of structure and function. All these instances, then, combine to show us that the insectivores are really a decadent order, surviving for the most part only under two sets of conditions—either in islands and peninsulas, far from the fierce competition of the great continents; or, if on the continents, then under special circumstances of life—nocturnal, subterranean, or aquatic—where they have been spared the competition in its worse forms, or have been endowed with special modes of defence by spines or bristles, which enable them to hold their own somehow against otherwise better adapted competitors.

Of all the insectivores, however, the shrews are the most central and least differentiated existing kind; and it is this fact which gives them their deepest claim to respect in the eyes of the evolutionary naturalist. For the insectivores themselves, as Professor Huxley has long insisted, are, in many respects, the most central order in the great division of mammals above the marsupials—the Placentata of most modern authors. Hence we may say, without exaggeration, that the shrew comes nearer than any other existing animal to the prime ancestor of the whole superior mammalian stock. There are many points, indeed, in which some of the abnormal and very archaic isolated insectivores strongly recall the marsupial type, and especially that of the phalangers. Thus the shrews are by no means remotely related on the one hand to the extremely ancient pouched animals, the most primitive (geologically speaking) of all known mammals; while, on the other hand, the curious isolated forms preserved for us in distant islands bridge over the gap to the hedgehogs and the bangsrings, as well as, perhaps in a less degree, to the carnivores, the lemurs, and the bats. Thus, the shrews in particular, and the insectivores in general, may be regarded as the great central junction of the entire mammalian line, whence the various diverging side-lines branch off in different directions towards all the chief families and orders of mammals, up to the lions, the elephants, the horses, the bats, the monkeys, and even man himself.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XX.

IN my last I described generally the diffusion of liquids, and the actions to which the names of *endosmosis* and *exosmosis* have been given. It is easily seen that in extracting the juices of meat by immersion in water the work is done by these two agencies. This is the case whether the extraction is effected by maceration (immersion in cold water) or by stewing.

Some of these juices, as already explained, exist between the fibres of the meat, others are within those fibres or cells, enveloped in the sheath or cell membrane. It is evident that the loose or free juices will be extracted by simple diffusion; those enveloped in membranes by exosmosis through the membrane. The result must be the same in both cases; the meat will be permeated by the water, and the surrounding water will be permeated by the juices that originally existed within the meat. As the rate of diffusion—other conditions being equal—is proportionate to the extent of the surfaces of the diverse liquids that are exposed to each other, and as the rate of osmosis is similarly proportioned to the exposure of membrane, it is evident that the cutting-up of the meat will assist the extraction of its juices by the creation of fresh surfaces; hence the well-known advantage of mincing in the making of beef-tea.

It is interesting to observe the condition of lean meat that has thus been minced and exposed for a few hours to these actions by immersion in cold water. On removing and straining such minced meat it will be found to have lost its colour, and if it is now cooked it is insipid, and even nauseous if eaten in any quantity. It has been given to dogs and cats and pigs; these, after eating a little, refuse to take more, and when supplied with this juiceless meat alone, they languish, become emaciated, and die of starvation if the experiment is continued. Experiments of this kind contributed to the fallacious conclusions described in No. 6 of this series. Although the meat from which the juices are thus completely extracted is quite worthless *alone*, and meat from which they are partially extracted is nearly worthless *alone*, either of them becomes valuable when eaten with the juices. The stewed beef of the Frenchman would deserve the contempt bestowed upon it by the prejudiced Englishman if it were eaten as the Englishman eats his roast beef; but when preceded by a *potage* containing the juices of the beef it is quite as nutritious as if roasted, and more easily digested.

Graham found that increase of temperature increased the rate of diffusion of liquids, and in accordance with this the extraction of the juices of meat is effected more rapidly by warm than by cold water, but there is a limit to this advantage, as will be easily understood by referring back to No. 3, in which is described the conditions of coagulation of one of these juices—viz., the albumen, which at the temperature of 134° Fahr. begins to show signs of losing its fluidity; at 160° becomes a semi-opaque jelly; and at the boiling-point of water is a rather tough solid, which, if kept at this temperature, shrinks, and becomes harder and harder, tougher and tougher, till it attains a consistence comparable to that of horn tempered with gutta-percha.

I have spoken of beef-tea, or *Extractum Carnis* (Liebig's Extract of Meat), as an extreme case of extracting the juices of meat, and must now explain the difference between this and the juices of an ordinary stew. Supposing the juices of the meat to be extracted by maceration in cold water, and the broth thus obtained to be heated in order to alter its raw flavour, a scum will be seen to rise upon the surface; this is carefully removed in the manufacture of Liebig's extract or the preparation of beef-tea for an invalid, but in thus skimming we remove a highly-nutritious constituent—viz., the albumen, which has coagulated during the heating. The pure beef-tea, or Extractum Carnis, contains only the kreatine, kreatinine, the soluble phosphates, the lactic acid, and other non-coagulable saline constituents, that are rather stimulating than nutritious, and which, properly speaking, are not digested at all—*i.e.*, they are not converted into chyme in the stomach, do not pass through the pylorus into the duodenum, &c., but, instead of this, their dilute solution passes like the water we drink directly into the

blood by endosmosis through the delicate membrane of that marvellous network of microscopic blood-vessels which is spread over the surface of every one of the myriads of little upstanding filaments which, by their aggregation, constitute the villous or velvet coat of the stomach. In some states of prostration, where the blood is insufficiently supplied with these juices, this endosmosis is like pouring new life into the body, but it is not what is required for the normal sustenance of the healthy body.

For ordinary food, all the nutritious constituents should be retained, either in the meat itself or in its liquid surrounding. Regarding it theoretically, I should demand the retention of the albumen in the meat, and insist upon its remaining there in the condition of tender semi-solidity, corresponding to the white of an egg when perfectly cooked, as described in No. 4. Also that the gelatine and fibrin be softened by sufficient digestion in hot water, and that the saline juices (those constituting beef-tea) be *partially* extracted. I say "partially," because their complete extraction, as in the case of the macerated minced-meat, would too completely rob the meat of its sapidity. How, then, may these theoretical desiderata be attained?

It is evident from the principles already expounded that cold extraction takes out the albumen, therefore this must be avoided; also that boiling water will harden the albumen to leathery consistence. This may be shown experimentally by subjecting an ordinary beef-steak to the action of boiling water for about half an hour. It will come out in the abominable condition too often obtained by English cooks when they make an attempt at stewing; an unknown art to the majority of them. Such an ill-used morsel defies the efforts of ordinary human jaws, and is curiously curled and distorted. This toughening and curling is a result of the coagulation, hardening, and shrinkage of the albumen as described in No. 3.

It is evident, therefore, that in stewing, neither cold water nor boiling water should be used, but water at the temperature at which albumen just begins to coagulate—*i.e.*, about 134°, or between this and 160° as the extreme. But here we encounter a serious difficulty. How is the unscientific cook to determine and maintain this temperature? If you tell her that the water must not boil, she shifts her stewpan to the side of the fire, where it shall only simmer, and she firmly believes that such simmering water has a lower temperature than water that is boiling violently over the fire. "It stands to reason" that it must be so, and if the experimental philosopher appeals to fact and the evidence of the thermometer, he is a "theorist."

The French cook escapes this simmering delusion by her common use of the "bain-marie" or "water-bath," as we call it in the laboratory, where it is also largely used for "digesting" at temperatures below 212°. This is simply a vessel immersed in an outer vessel of water. The water in the outer vessel may boil, but that in the inner vessel cannot, as its evaporation keeps it below the temperature of the water from which its heat is derived. A carpenter's glue-pot is a very good and compact form of water-bath, and I recommend the introduction of this apparatus into kitchens where a better apparatus is not obtainable. Some ironmongers keep in stock a form of water-bath which they call a "milk-scalder." This resembles the glue-pot, but has an inner vessel of earthenware, which is, of course, a great improvement upon the carpenter's device, as it may be so easily cleaned.

One of the incidental advantages of the *bain-marie* is that the stewing may be performed in earthenware or even glass vessels, seeing that they are not directly exposed to the fire. Other forms of such double-vessels are obtainable at the best ironmongers. I have lately seen a very neat apparatus of this kind, called "Dolby's Extractor." This consists of an earthenware vessel that rests on a ledge, and thus hangs in an outer tin-plate vessel; but, instead of water, there is an air space surrounding the earthenware pot. A top screws over this, and the whole stands in an ordinary saucepan of water. The heat is thus very slowly and steadily communicated through an air-bath, and it makes excellent beef-tea; but, being closed, the evaporation does not keep down the temperature sufficiently to fulfil the above-named conditions for perfect stewing. At temperatures *below the boiling-point* evaporation proceeds superficially, and the rate of evaporation at a given temperature is proportionate to the surface exposed, irrespective of the total quantity of water; therefore, the shallower the inner vessel of the *bain-marie*, and the greater its upper outspread, the lower will be the temperature of its liquid contents when its sides and bottom are heated by boiling water. The water in a basin-shaped inner vessel will have a lower temperature than that in a vessel of similar depth, with upright sides, and exposing an equal water surface. A good water-bath for stewing may be extemporised by using a common pudding-basin (I mean one with projecting rim, as used for tying down the pudding-cloth), and selecting a saucepan just big enough for this to drop into, and rest upon its rim. Put the meat, &c., to be stewed into the basin, pour hot water over them, and hot water into the saucepan, so that the basin shall be in a water-bath; then let this outer water simmer—very gently, so as not to jump the basin with its steam. Stew thus for about double the time usually prescribed in English cookery-books, and compare the result with similar materials stewed in boiling or "simmering" water.

THE SUN'S DISTANCE.*

By Professor R. S. Ball, LL.D.,

Astronomer-Royal for Ireland.

(*Continued from page* 199.)

IT has often been observed that at a meeting of the British Association the proceedings assume a certain tone in harmony with those branches of science with which our President for the time being has been specially identified. In recognition of this principle, which is both useful and appropriate, the first method which I shall allude to this evening is the exquisitely beautiful mathematical calculation by which the distance of the sun can be elaborated from ordinary observations of the planets systematically conducted at our national observations. This method was foreshadowed in the dynamical theory of Newton, and was wrought to perfection by Leverrier. It is based upon the great law of gravitation, and is intimately connected with the splendid discoveries in planetary perturbation which form so striking a chapter in modern astronomical discovery. There is a certain relation between two quantities, which, at first sight, seem quite independent. These quantities are the mass of the earth and the distance of the sun. It follows from the measurements of the intensity of gravitation on the earth's surface, and from the known revolution of the earth around the sun, that the sun's parallax has a determined ratio to the cube root of the mass of the earth. There is no un-

* A discourse delivered at the second general meeting of the British Association at Southport.

certainty about this result, and the consequence is obvious. If we have the means of weighing the earth in comparison with the sun, then the distance of the sun can be immediately deduced.

How, then, are we to place our great earth in the weighing scales? This is the problem which Leverrier has shown us how to solve, and he does so by invoking the aid of the planet Mars. If Mars in his revolution around the sun were solely swayed by the attraction of the sun, he would, in accordance with the well-known laws of planetary motion, follow for ever the same elliptic path. At the end of one century, or even of many centuries, the shape, the size, and the position of that ellipse would remain unaltered. Fortunately for our present purpose, a disturbance in the orbit of Mars is produced by the earth. Although the mass of the earth is so much less than that of the sun, yet the earth is still large enough to exercise an appreciable attraction on Mars. The ellipse which Mars follows is not always the same. The shape of that ellipse and its position gradually change, and the position in which the planet is found depends upon the mass of the earth. The place in which the planet is found can be determined by observation; the place which the planet would have had if the earth were absent can be found by calculation. The difference between the two is due to the mass of the earth, and when it has been measured the mass of the earth can be ascertained. The amount of displacement increases from one century to another; but, as the rate of growth is small, ancient observations are necessary to enable the measures to be made with accuracy.

A remarkable occurrence, which took place more than centuries ago, enables the place of Mars to be determined with great precision. On the 1st of October, 1672, three independent observers witnessed the occultation of the star ψ Aquarii by the planet Mars. The place of the star is known with accuracy, and hence we are provided with the means of accurately defining the point on the heavens occupied by Mars on the day in question. From this result, combined with the modern meridian observations, we learn that the displacement of Mars by the attraction of the earth has in the lapse of two centuries grown to about five minutes of arc (294 seconds). It has been maintained that this cannot be erroneous to the extent of more than a second, and hence it would follow that the earth's mass is determined to within one three-hundredth part of its amount. If no error were present, this would give the sun's distance to about one nine-hundredth part part, which approaches very closely to the limit we have indicated.

Notwithstanding the intrinsic beauty of this method, and the very high auspices under which it has been introduced, it will, I think, hardly be found to fulfil all the needful conditions. We make no impeachment of the fidelity of the observations, and we feel no doubt that the displacement of the planet is mainly, if not entirely, due to the disturbing effect of the earth's attraction; but it seems quite impossible to be sure that some other cause, minute though it must be, may not also have contributed to the result. We cannot be absolutely sure that the theory is above suspicion. Interesting and beautiful though this method may be, we must rather regard it as a striking confirmation of the law of gravitation than as affording an accurate means of measuring the sun's distance.

Several other methods have been employed by which we can place the earth in the weighing scales. Perhaps none of these methods is free from objection as a means of measuring the sun's distance. I must, however, mention one of them which has special claims on our attention of a very peculiar kind.

This time we invoke the aid of that erratic member of our system known as Encke's comet. The comet completes a circuit around its ellipse in a period but little more than three years. It does not, however, move with uniform velocity. Around the remote part of its path the comet creeps languidly; but as it turns round and commences to approach the sun the pace gradually improves, and the comet itself swells up in dimensions and in splendour. Encke's comet, although so famous, is one of that numerous host of telescopic objects which seldom or never become bright enough to be visible to the unaided eye. It can only be seen when comparatively close to the sun. All around the outer part of its path it is totally invisible in the most powerful telescope. The comet itself is shown here. It is a dull hazy spot of light, evidently composed of materials of a filmy, or almost spiritual texture. A great comet is usually attended by a long tail. This small telescopic comet is not so decorated.

Notwithstanding the insignificance of Encke's comet, it is capable of giving us very interesting information acquired during its somewhat eccentric travels through the solar system. It is, for instance, able to weigh the earth, and thus to afford the means of measuring the sun's distance. The elliptic path which the comet describes is, of course, mainly due to the preponderating influence of the sun's attraction. If there were no source of disturbance the comet must follow that eclipse inflexibly and never deviate therefrom. But the planets insist on asserting their power, the orbit of the comet is disturbed, and that orbit is so eccentric that the disturbances occasionally attain to enormous dimensions.

For instance, when the comet draws near the sun it passes very close to the track of Mercury. It has happened that the comet arrives at Mercury's orbit at the same moment that Mercury arrives at the comet's orbit. Such a *rencontre* may bring the comet and the planet within a couple of million miles, which is quite an insignificant distance in measures of this description. In such a case the comet and the planet attract each other with vehemence. The solid mass of Mercury drags the comet from its path, though the flimsy and unsubstantial comet can impress no measurable disturbance on the movements of Mercury. In its outward career the comet sometimes approximates to Jupiter, in which case the great planet contributes its potent aid to the derangement of the comet. The earth, also, although its path lies more distant from the track of the comet is still able to contribute a little further disorder, so that the path which the comet really pursues is one of amazing complexity. It is the task of the astronomer to survey that path, to determine its shape and its position, and to ascertain the epochs at which the comet accomplishes each successive stage on its never-ending journey.

This work being done, the problem is now one for the mathematician. It is for him to decompose the complicated movement into its constituent elements. He discriminates first the great elliptic motion due to the attraction of the sun. Superimposed on the elliptic motion he finds the smaller and more perplexing movements due to the planetary disturbance. He can disentangle the effect due to the earth's attraction from that due to Mercury and to Jupiter. This work has been done in a masterly manner by the late distinguished Russian astronomer Von Asten, and he has elicited the mass of the earth from a most recondite inquiry, embracing some twenty complete revolutions, during which the comet has been observed. It would, however, be unwise to assign much weight to the distance of the sun, which may be deduced from these researches. Notwithstanding the labours of many astronomers, the

theory of the comet's motion is still not sufficiently perfect for this purpose. It cannot be pretended that this method would give the sun's distance to within a thousandth part, and accordingly this method must give place to those which have more claims to accuracy.

(To be continued.)

Editorial Gossip.

Mr. Herbert Spencer has shown the scientific aspect of systems of government, so I need not apologise for touching on the subject here. Now our Constitution is our pride, the glory of our British hearts. Never did man so offend our race as when Prince Albert told us that the British Constitution was on its trial. In theory how beautiful it is. Each man has power, if he but earn decent wages, to take a part in the management of matters—a little part but still a part. Then the management of matters by the State is so providently extending itself to matters with which the State might be supposed to have nothing or little to do! The State has been awfully unlucky (let us put it that way) in the management of matters it might have left alone. But still our people have a touching confidence in the perfect wisdom of the legislature, its power to arrange just right such things as hitherto it has singularly mismanaged. Yet it is a little odd, slightly perplexing to those who look at matters from without, to find that individual members of the elected body of lawmakers, are for the most part, when standing in the position of candidates, considered no wiser or better than their fellows—nay, strangely enough, these embodiments of national wisdom, are usually denounced in the roundest (but by no means the rosiest) terms before election. Somehow the elected body differs utterly in kind from the same set of men when as yet unelected.

But this is not all that perplexes the student of the matter. Among the elect, we see rather more than one-half starting off at a pace which the rest find rather too fast or rather too slow, and that as a result of this diversity of views, each section finds the other section contemptible and hateful,—the more pronounced on either side being more hated and despised, despising also and hating more intensely, than their fellows, but every representative of the collective wisdom regarding much more than half of his fellows as exceedingly unwise. Our daily papers so carefully teach us that whole sections of our collective wisdom are hateful and despicable, while they so completely represent (among them) *every* section, that the general effect to outsiders is depressing — one might almost say (not using the word in any offensive sense) distressing. How other nations are impressed one may guess by considering how we ourselves, after steady daily reading of American papers for a few months, learn to revere the Congress, Senate, and Legislature of our cousins over the water. An Englishman by keeping close to one party paper may learn to believe that among a section of the representatives of his people there is a little honesty and a little sense. But if by chance he should take up the wrong paper he will find even that one section vilified so unsparingly that he will not know what to think (though foreigners may). But perhaps, he may think, among the real leaders of the two chief sections, or of their sub-divisions, there may be none of this feeling of hatred and contempt. Even this hope is denied the thoughtful Briton however, when, reading the words of one who is supposed to be a chief leader of the section which as it chances is not now having its innings, he comes on such words as these, "There is work for us all and a place in the ranks for each of us, in face of *the common enemy*,"—the "common enemy" being simply the other section of the collective wisdom which the nation asks so confidingly to manage its business. The masts of the State ship may be perhaps made firm and strong by stays tautened well on opposite sides; but to tell the crew that all the port shrouds are rotten (or all the starboard ones, as the case may be), is not encouraging; while to go further and to tell the starboard watch that the best thing they can do is for each to help in cutting the port shrouds, is beyond measure mischievous if those shrouds are sound and as good as giving up the ship if they are really as rotten as asserted. If each of the chief sections of our Houses of Parley is really regarded by the other as the "common enemy," one should be rather disposed to wonder that constitutional government still *remains* "on its trial."

The amusing confidence with which Mr. Charles Mackay, in the *Pall Mall Gazette*, asserts that the word *Masher* is derived from the Irish *maise*, similarly sounded (!), and meaning an "exquisite" or *petit-maître*, would seem to suggest that he was present when the word was first used, and had carefully traced its subseqent spread in America. It was "introduced by the Irish immigration," he tells us. If so, the case is an interesting one; for the Irish who speak the old language have not been able to introduce many of their words into common use among Americans, and their talk would not be very commonly about dandies. "In strange contrast with the Dandiacal Body," says Carlisle, "stands" that other sect, "originally of Ireland," and there known "by a perplexing multiplicity of designations such as *Bog-Trotters*, *Redshanks*, *Ribbonmen*, *Cottiers*, *Peep-of-Day Boys*," &c. That members of this sect should have brought into use an American slang word for dandies is so unlikely that one could hardly believe it, even if there were no other probable derivation of the word.

But while, to begin with, the word "maise" is not pronounced like "masher" (except to rather dull and uncritical hearing) and while, to go on with, the word "masher" as first used in America did not signify dandy, the derivation of the word is so obviously American that it would be as absurd to go to a foreign language for it as it would be to seek some Norse or Arabic origin for the familiar term "Crusher." The word "masher" was first used in America, and in 1879 (when I first noticed it in American papers) was constantly used as almost the equivalent of our term a "lady-killer," and was applied especially to a class of fellows who made themselves obnoxiously obtrusive to ladies travelling alone. It was only later that it was used to indicate the general style of costume employed by these offensive persons, and gradually lost a portion (only) of its originally contemptuous meaning. As the word "mash" is used in America to signify crushing, hurting (something between pinching and smashing), the suitability of the word "masher" is obvious. Just as we speak of a "lady-killer," a "killing dress," a "crushing costume," and so forth, a dandy dressed to kill and going about like a braying jackass seeking whom he may molest with impertinent addresses, is (or rather was) called contemptuously a "masher." There was more bitterness than fun in the early use of the term. It does not appear in Bartlett's

"D ctionary of Americanisms," fourth edition, 1877. But it began to be used about that time. It had been earlier applied by the profession (stage) to those who wished to be actress-killers.

A POEM suggested by four of my lectures on astronomy has come to me this week. My usual rule has been to have no poetry in these columns, although there are some subjects of scientific study which seem to lend themselves very suitably to poetic treatment. In the present case, an exception has been made, to which I trust readers will not take exception.

VOICES OF THE SUNS.*

BY VEGA.

I WATCHED the depths of darkness infinite
Bestrewn with stars, till dreaming I beheld
From out the mystic realms beyond my ken
A star come forth with even gliding rush:
Till sweeping onwards shone its orb
With all the mighty meaning of a sun,—
A sun girt round by many-peopled worlds,
And worlds as yet not peopled being young,
And worlds long since unpeopled being old
And dead. Their ruling sun shone on them—
On the living, on the yet unfashioned,
On the dead: on all it shone, though idly
Where as yet life had not sprung from forth
The teeming womb of time; and idly too
Where life had ceased to be. On all those worlds
The mystic force which lives in matter worked
Its mighty will. Dead worlds and worlds scarce born
And worlds alive with myriad forms of life
Swept circling round that stately ruling orb.
As it sailed past I heard its solemn voice
Proclaiming through the realms of space the song,
The everlasting song of Life and Death—
Of wealth of Life and everduring waste
And dearth of Life. It sang of present, past,
And coming plenitudes of Life; of past
And coming wastes of Death: infinitudes
At once of Life and Death; each without end,
Without beginning each. "Along my path—
In front," it said, "and backwards whence I came—
And all around, above below my course,
Lie millions such as I, through endless realms
Of star-strewn space. There is no end to God's
Domain of suns and systems ruled by suns—
No end and no beginning through all space—
But everlasting, mystic, wonderful,
The song of us sounds ever round the throne
Of Him who reigns supreme, the Life of All—
UNKNOWN! yea evermore UNKNOWABLE!"
Then as the Psalmist sang of old I said—
Because, so moved, I could not choose but speak—
"What Lord is man that Thou should'st care
For him or for his kind, the son of man that Thou
Should'st mindful be of him or his?" Then rang
A voice of solemn thunder through the spheres
"Say rather, What is Space or Time to Me,
That thou should'st deem mere mightiness of mass
And plenitude of time can outweigh mind
And soul? Can worlds and suns My power know?
Can æons after æons sing My praise as man
Gifted by Me with power to know My power, can tell
The meaning of the music of My spheres?
Then I said, "Nay Lord, but if the words
Of men are worth the utterance, they are thine.
Lo we are but the creatures of Thy hand.
We see but part of all Thy wondrous work.
Could we but see the glory of Thy Light,
Could we but hear the thunder of Thy Power,
We should become both blind and deaf—
Deafened by strident tones, made blind by light.
In Thee alone we live and move, in Thee
We have our being. But shall we, finite, hymn
The praises of Thine Infinite? Shall weak man,
The creature, paint with erring brush the Sun
Of Might and Power and Wisdom evermore supreme?"

* * * * *

The answer came, "Shalt thou, My creature, doubt,
Or hold My Will in question? Learn that the least
Of all the minds My Will has made
Outweighs not once but many thousand times
The mightiest mere mass: the thoughts of human hearts
Outvie the movements of a million suns,
The rush of systems infinite through space.

* Lines suggested by four lectures on Astronomy (Birth and Death of Worlds, The Sun, The Moon, and The Star Depths).

WEATHER FORECASTS AND HOW TO MAKE THEM.

BY JOHN BROWNING, F.R.A.S.

THE RAIN-BAND SPECTROSCOPE.

THE rain-bands are like the Fraunhofer lines, at right angles to the spectrum, but instead of being sharply-defined, they are simply shaded bands, which appear darker as rain becomes imminent. When they are very prominent they are more conspicuous than any of the Fraunhofer lines.

Almost the only difficulty experienced in using the spectroscope for observing the rain-band is that of knowing where to look for the band or bands in the spectrum.

By using the spectroscope in the manner now to be described, and carefully consulting the engravings here given, I trust this preliminary difficulty will be avoided. Take the spectroscope in the left hand, and looking through the eye-piece *with the sliding tube towards the eye*, direct the instrument towards a white cloud at about 20° or 30° above the horizon, that is, at about from one quarter to one-third of the distance from the horizon to the zenith, or, in other words, overhead. If the instrument has an adjustable slit, close the jaws by turning the largest milled ring at the opposite end to the eye-piece from left to right, while you are looking through it, until lines begin to appear in the direction of the *length* of the spectrum. Then slowly and carefully open the jaws of the slit until these horizontal lines disappear. Now turn the red end of the spectrum towards the left, and examine the coloured riband of light graduating from red through orange, yellow, green, and blue into violet, known as the spectrum.

Fig. 1.

Just where the red and yellow meet in the spectrum there is a fine line across the spectrum which is known as the D line. In the ordinary rain-band spectroscope (Fig. 1)

this line appears single, but with the slit shut as closely as possible, and the light from the sky very strong, when the observer is possessed of good eyesight, it is just possible to see that this D line is really double—the finest imaginable line of light appearing exactly in the middle of it, and thus dividing it into two.

Fig. 2.

Whenever there is moisture in the air which is likely to fall as rain, this D line (or lines) appears thicker and blacker, and on the side towards the red there is a shaded band from two or three to five or six times the breadth of the D line. This band has been named the *rain-band*. If this band is very dark and broad, and is visible when the spectroscope is directed towards the sky, at an angle of 45°—that is half-way between the horizon, and directly overhead—then rain may be confidently expected in from six to twelve hours.

In Fig. 2 I have given an engraving of the D lines in the spectrum when there is no rain-band present, and in Fig. 3 an engraving of the spectrum, with a very strong rain-band showing in it such as I have just described, as indicating that rain is imminent. The two strong lines in the shading to the left of the D will not be shown by any low-power spectroscope of the ordinary construction.

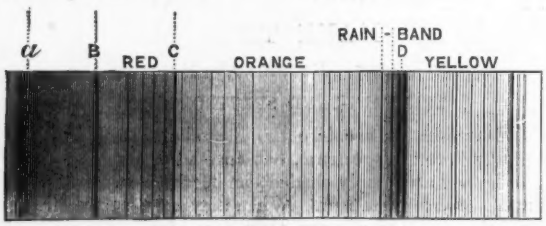


Fig. 3.

It must be understood that this band may appear of any degree of intensity, from even darker than it is shown in Fig. 3, to the faintest sign of its presence in the spectrum.

Some little practice is necessary to estimate the intensity of the rain-band; but this knowledge is generally soon acquired.

To fairly estimate the probability of rain and the time at which it may be expected, it is necessary to observe carefully the intensity of the rain-band at different degrees of elevation above the horizon.

An hour or two after sunrise there is mostly a slight rain-band visible near the horizon. This I should call *a low, faint rain-band*. It would be wrong to conclude that this appearance will be necessarily followed by rain. It is a good plan to make rain-band observations about nine o'clock in the morning, and to observe most particularly, when the rain-band is seen, how high up in the sky it is visible.

In estimating the intensity of the rain-band, Mr. Rand-Capron gives a series of diagrams of the rain-band, six in number, and refers all his observations to one of these, estimating the variation in its intensity to about from fifteen to twenty per cent.

Mr. Corry, who has written some excellent letters to Knowledge on this subject, assures me that after only a few weeks' practice, he had no difficulty in estimating its intensity to ten per cent.

I find for beginners it is sufficient to estimate the intensity to twenty-five per cent., according to four degrees of intensity, of which Fig. 3 may be considered as the third, equalling seventy-five per cent.

I cannot get diagrams engraved on wood of sufficient accuracy and delicacy to represent even these four degrees of intensity.

The diagrams given are, for wood-cuts, by far the best I have seen, and do the engraver great credit; but even their preparation to my satisfaction has caused a month's delay in the appearance of these articles.

I have referred first to the shaded band only in the spectrum, because this only is shown in the simplest and most inexpensive spectroscopes.

Professor Piazzi-Smyth, who first suggested the use of the spectroscope for predicting rain, used an exceedingly powerful and costly instrument for the purpose, in which the rain-band was shown *as a number of separate lines*.

Fig. 4.

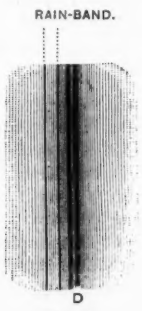


Fig. 5.

Thanks to the ingenuity of Mr. Grace, we are now provided with a portable spectroscope at a very moderate expense, which will clearly show the two principal *lines* in the rain-band. These two lines are shown in the diagram, Fig. 4, and again, with the shading by which they are always accompanied when they are strong, in Fig. 5, and also in Fig. 3. The ordinary small spectroscope will

Fig. 6.

not, I repeat, show these *lines*. Grace's spectroscope is shown in Fig. 6. Until I was able to supply this instrument, a great number of my correspondents were not able to *see*, let alone estimate, the intensity of the rain-band.

In my next article I shall refer to the angle of disappearance of the rain-band, the best method of making and recording observations, and the practical conclusions to be deduced from them.

EPHEMERA, OR DAY FLIES.

THESE insects belong to the family which is scientifically called Ephemeridæ. They are called day flies on account of their short life, a single day sometimes witnessing their entrance into a perfect state of development and their death. They pass about two years in their larval and pupal state.

These insects are interesting and remarkable for a stage of development which is very uncommon. When they forsake the water where their larval and pupal state is passed they creep out of the pupa case, and after resting for a short period—from one to twenty hours—begin a tremulous motion of their wings. Then they fly to the

trunk of a tree, or to the stem of some water plant, and cast off a thin membranous skin, which has enveloped the body and wings; and fly quickly away before the eyes of the observer, leaving this skin resting upon the stem, looking at first like a dead insect. After this operation the wings are much brighter. The state between leaving the water and casting off the skin is called "pseudimago."

These day flies were known to the ancients. Aristotle says "that about the time of the summer equinox he observed on the shore of one of the rivers which empties into the Bosphorus, little sacs, from which insects would creep out and fly about until evening, then grow weary and die at the setting of the sun. They were called on this account day flies."

On a quiet May or June evening these insects may be seen flying about, sometimes in great numbers, their gauze-

like wings irradiated by the rays of the setting sun. They fly without any visible motion of their wings, and seem to drink in joy and pleasure in the few hours which lie between their appearance and disappearance, their life and death.

They measure from 17 to 19 millimètres without the tail filaments, which in the female are of the same length as the body, but in the male double the length.

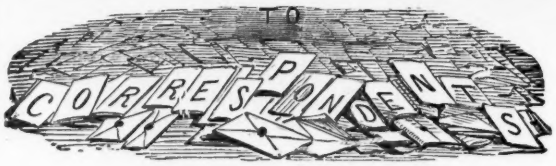
The larvæ inhabit the water, and have upon each side of the back part of the body six tufts or tassels; the head runs forward into two points, and has fine hairy feelers; the legs are smooth, the front ones the strongest, and adapted for digging. They are fond of hiding under stones or burrowing into the sandy shores, and make a very curious tunnel, something like a double-barrelled gun, which is often 52 millimètres deep.—*From Brehm's "Animal Life," Scientific American.*

THE FACE OF THE SKY.

From Oct. 12 to Oct. 26.

By F.R.A.S.

THE telescope should be directed to the Sun on every clear day. The aspect of the night sky may be gathered from Map X. of "The Stars in their Seasons." Mercury is now a morning star, and, about the time of his greatest western elongation from the Sun on the 22nd, may be seen near the horizon before sunrise somewhat to the south of east, by any one who will get up soon, or sit up late enough for that purpose. Venus, for all practical purposes, continues invisible. Mars gets slowly larger; but his angular diameter only amounts to 8″·8 by the 26th, so that very little in the shape of detail is visible upon his face. He rises about 10 h. 21 m. p.m. on the 26th. Jupiter will be in so-called "Conjunction" with Mars on the night of the 19th Jupiter being about 59′ to the south of him. As both planets are so close together in the sky, it is needless to add that they are equally indifferently placed for the observer. Saturn, rising sooner and sooner every night, will be above the horizon about 6h. 19m. p.m. by October 26. His superficial details can now be studied very advantageously. Uranus is invisible; but Neptune, as we said a fortnight ago, may be found as a small 7th mag. star to the S. and E. of δ Arietis. The age of the moon to-day at noon is 11·3 days and pretty obviously, on the 26th it will be 25·3 days. During the early morning of the 16th there will be a partial eclipse of the moon. The first contact with the penumbra (or faint edge of the Earth's shadow) will occur at 4h. 42·4m. a.m. The first contact with the real shadow, at 5h. 59·1m. a.m., and the middle of the eclipse at 6h. 54·3m. a.m., Greenwich mean time. Before this, though, the moon will have set. If we call the moon's diameter 1, only 0·277, or less than three-tenths of it, will be covered at the time of greatest obscuration. Two occultations only of fixed stars by the moon will occur during available hours within the next fourteen days. The first is that of the 6th mag. star B.A.C. 1272, which will disappear on October 18 at the Moon's bright limb at 7h. 48m. p.m., at an angle of 36° from her vertex, to reappear at her dark limb at 4h. 35m. p.m., at a vertical angle of 267°. The second occultation happens on the 21st, when one minute after midnight λ Geminorum, a star of the 3½ mag., will disappear at the moon's bright limb at a vertical angle of 55°. It will reappear from behind her dark limb at an angle of 216° from her vertex at 1 h. 2m. a.m. on the 22nd. The Moon will be in Aquarius all day to-day and to-morrow until about 8 p.m., when she will cross the boundary into Pisces. It will be four o'clock in the afternoon of the 16th before she has completed her path across this great constellation, and entered Aries. She will reman in Aries until 4 a.m. on the 18th, at which time she will cross the boundary into Taurus. Her path through this constellation will occupy until 1 p.m. on Saturday 20th, when she will pass into the northern part of Orion. She will be until two o'clock the next morning crossing this, and will then enter Gemini. Here she will continue until six p.m. on the 22nd, when she enters Cancer. She will not quit Cancer until 10 a.m. on the 24th, when she crosses into Leo. Some twenty-four hours later she descends into Sextans. About seven a.m. on Oct. 26 she re-enters Leo, and is still crossing that constellation at midnight on the 26th.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

PONS'S COMET.

[953]—The comet that was first detected by Brooks, on September 2, and subsequently seen by Mr. Wendall, of Harvard College, and also at Lord Crawford's observatory, Dunecht, was observed by me in Liverpool, on the night of October 3; its right ascension being 16h. 14m. and declination north 58° 25′, therefore it is about 3° 22′ south-west of η Draconis; from this data its position can easily be determined by reference to Proctor's "Star Atlas."

Seen through a 30-inch achromatic, with a magnifying power of 60, it presented the appearance of a globular vaporous disc, showing a slight degree of condensation towards the centre—no stellar point could be discerned with the power employed. A star (of about the 9th magnitude), which shows no diminution in brilliancy, can be seen shining through the nebulous edge of the cometary disc.

It is supposed to be identical with Pons's comet of 1812, which has a period of about seventy-two years. W. K. Bradgate.

SOFTENING WATER.

[954]—In a guide to the Fisheries Exhibition now before me, I find an allusion to Atkins's process of softening hard water, "which turns lime in solution into a solid bi-carbonate."

Would you or any one of your intelligent readers kindly inform me of the nature of this process. Lewis James.

HULL-DOWN SHIP.

[955]—Referring to the query of "H. A. L. S.," No. 951, page 219, I think Mr. Proctor has missed the correct explanation. I have little doubt that the disappearance and reflection described was caused by a layer of air of *less*—not of *greater*—density than that above it. It is a well-known law in optics that light cannot pass from a medium of higher into one of lower refractive power at anything beyond a certain degree of obliquity. When this obliquity is exceeded, total reflection occurs, the rarer or less refracting medium is absolutely opaque to the incident rays, though the film of this medium be no thicker than gold-leaf.

If at the time when "H. A. L. S." made his observation the sea was warmer than the air above, such a film of warmer air would be in contact with the surface of the water, and the rays coming from the hull-down ship would strike the bending horizon surface at the maximum of possible obliquity, and, therefore, suffer total reflection. A portion of the sea itself would thus be hidden and replaced visually by a mirror-like surface easily confounded with the sky beyond.

This is rarely seen over an unbroken sea horizon, but is an every day (*i.e.*, every sunny day) phenomenon wherever there is a stretch of sea bounded by an horizon of gradually sloping land, especially if that land be rocky and dark coloured, like the glaciated islet rocks on the Arctic coast of Norway. There the air, heated by contact with the warm rock, renders the rock itself invisible up to a certain height, and makes it appear as though suspended in the air.

This form of mirage is curious in itself, but I have observed something else connected with it that is still more curious, viz., that sailors and fellow-tourists to whom I have pointed it out had never observed it before, though they must have seen it hundreds or thousands of times. In "Through Norway with a Knapsack,"

I describe it in detail, and show how it explains the sea-serpent of the old Norsk traditions; not the puny thing of a few hundred feet long described by modern observers, but the veritable Kraken, three or four and more miles long. I saw him myself, of such dimensions, and have pictured him in the last edition (1876) of that work.

W. Mattieu Williams.

[Mr. Williams's explanation seems to me scarce consistent with the observed phenomena. A film of rarer air would have shown the rest of the upper masts, sails, &c. So would a film of denser air; but in this latter case the sea horizon and surface would be seen, and the reflected masts, &c., *below* the sea horizon would be lost—as was, in point of fact, the case. Of course if the film were limited in extent part of the upper rigging would be lost; but the parallelism of the observed sea limit with the true horizon would in that case be only explicable as a most marvellous coincidence.—R. F.]

SIR WILLIAM HERSCHEL.

[956]—I have only just seen letter 947 (p. 219), in a locality between 200 and 300 miles from my own library. Under these circumstances I really cannot say, off hand, the name of the work in which I found the statement as to the loss of an eye by Sir William Herschel; but, immediately on my return home, I will hunt up the reference and give it (as Colonel Herschel requests) in these columns, for the benefit of all interested in the matter.

A Fellow of the Royal Astronomical Society.

SMALL WHEELS *v.* LARGE WHEELS.

[957]—I have received so many letters from cyclists who have read my articles in Knowledge stating that they agree with what I have written on this subject, that I propose briefly replying to "Sigma's" last letter, and then withdrawing from the further discussion of this question.

With regard to the pace travelled by Mr. Marriott I had assured myself before writing, by comparing notes with a tricycling sporting expert, that the pace made by Mr. Marriott on the 40-inch "Humber" was faster than he travelled on the 42-inch "Humber" on a more level road in far better condition.

It was also faster, slightly, than Lowndes made over a better course on a "Coventry;" but if it had been slower, surely "Sigma" must see that would have had but little bearing on the matter.

The performance of the same man on the same class of machine first with large and then with smaller wheels is the criterion.

There is nothing in "Sigma's" suggestion that probably the "Humber" alone among tricycles may run better for having small wheels.

Mr. Salmon, as he stated in his lucid letter in last week's Knowledge, has been led to adopt small wheels from his experiments with a Coventry Rotary, Mr. Grace has done so after experimenting with rear-steerers of the "Meteor" type, while Mr. Howard and myself have used front-steerers of the "Salvo" type, and we have all arrived at the same conclusion.

Small wheels are certainly at no disadvantage in hill-riding, as compared with large wheels.

"Sigma" gives us one experiment he made with 44-in. wheels. I have tried hill riding on fifty machines, and I can ride Godstone-hill, the steepest incline I care to ride, on my 38-in. Humber, geared to 46-in., easier than on any other machine.

I can easily produce a witness that I have quite recently done this on the 38-in. machine if "Sigma" doubts my word.

I do not in any way refer to this as a feat, but name it because I have been compelled to dismount on this hill on every other machine but my 38-in., though that is geared to 46-in., while I have failed to ride it with 48-in. wheel machines geared down as low as 36 in. I have also failed to ride it on a 44-in. "Humber" geared level, by which I do not mean that I could not have struggled up, but that I preferred to dismount rather than run the risk of breaking a blood-vessel.

These systematic experiments prove to me conclusively that small wheels are at no disadvantage in hill-riding.

Mr. Salmon is correct in supposing that my articles in Knowledge are not written for the guidance of racing men, or even hard riders, but for those who are content to ride at a moderate speed, with a pleasurable amount of exertion.

If any novices should follow "Sigma's" advice and attempt to ride over hills with machines geared up to 60 inches, they will probably soon give up riding, voting it simple slavery. I write advisedly, for I have reconciled several men to riding who were about relinquishing it, by having their machines geared down to 46 inches when I found they were trying to ride machines with 50-in. wheels *geared level*, and in every instance, I believe, they were stronger men than myself.

I have a friend—a strong man and a good oarsman. Some time since he got a machine from a dealer. After riding for a few weeks he sold it. On inquiry I found it was a machine with 50-in. wheels geared up to 56. I did my best to persuade him to try another machine geared down, but he had been sickened. He replied that he was not afraid of work, but tricycling was something more than work, it was—and he said something with a very big D indeed.

Contrary to "Sigma's" suggestion in a former letter, I do not find that novices who are set to ride a machine which runs easily at a moderate pace, quickly become disgusted with tricycling.

John Browning,
Chairman of the London Tricycle Club.

P.S.—Mr. Shaw has written another long article in the *Tricyclist*, which I can dismiss in a postcript, as he has only one strong point in it. He asks why I do not propose to ride on geared-up castors? I might, with as much reason, have asked why he did not propose to build machines with wheels 160 in. in diameter instead of 60 in.? But I did not reply to him in this way, because I preferred to meet all his theoretical suggestions by statements of facts, or arguments based on experiments, without descending either to ridicule or even exaggeration.

DR. FRANKLIN'S MAGIC SQUARE OF SQUARES.

200	217	232	249	8	25	40	57	72	89	104	121	136	153	168	185
58	39	26	7	250	231	218	199	186	167	154	135	122	103	90	71
198	219	230	251	6	27	38	59	70	91	102	123	134	155	166	187
60	37	28	5	252	229	220	197	188	165	156	133	124	101	92	69
201	216	233	248	9	24	41	56	73	88	105	120	137	152	169	184
55	42	23	10	247	234	215	202	183	170	151	138	119	106	87	74
203	214	235	246	11	22	43	54	75	86	107	118	139	150	171	182
53	44	21	12	245	236	213	204	181	172	149	140	117	108	85	76
205	212	237	244	13	20	45	52	77	84	109	116	141	148	173	180
51	46	19	14	243	238	211	206	179	174	147	142	115	110	83	78
207	210	239	242	15	18	47	50	79	82	111	114	143	146	175	178
49	48	17	16	241	240	209	208	177	176	145	144	113	112	81	80
196	221	228	253	4	29	36	61	68	93	100	125	132	157	164	189
62	35	30	3	254	227	222	195	190	163	158	131	126	99	94	67
194	223	226	255	2	31	34	63	66	95	98	127	130	159	162	191
64	33	32	1	256	225	224	193	192	161	160	129	128	97	96	65

[958]—The chief properties of Dr. Franklin's Square which accompanies this, are as follow:—

1. The sum of the sixteen numbers in each column or row, vertical or horizontal, is 2,056.

2. Every half column, vertical or horizontal, makes 1,028, or just one half of the sum 2,056.

3. Any half vertical row, added to any half horizontal, makes 2,056.

4. Half a diagonal ascending added to half a diagonal descending, makes 2,056, taking these half diagonals from the ends of any side of the square to the middle of it, and so reckoning them either upward, or downward, or sideways.

5. The same with all the parallels to the half diagonals, as many as can be drawn in the great square; for any two of them being directed upward and downward, from the place where they begin to that where they end, make the sum of 2,056; thus, for example, from 64 up to 52, then 77 down to 65, or from 194 up to 204, and from 181 down to 191; nine of these bent rows may be made from each side.

6. The four corner numbers in the great square added to the four central ones make 1,028, the half of any column.

7. If the great square be divided into four, the diagonals of the little squares united make each 2,056.

8. The same number arises from the diagonals of an eight-sided square taken from any part of the great square.

9. If a square hole, equal in breadth to four of the little squares

XUM

or cells, be cut in a paper, through which any of the sixteen little cells may be seen, and the paper laid on the great square, the sum of all the sixteen numbers seen through the hole is always equal to 2056.

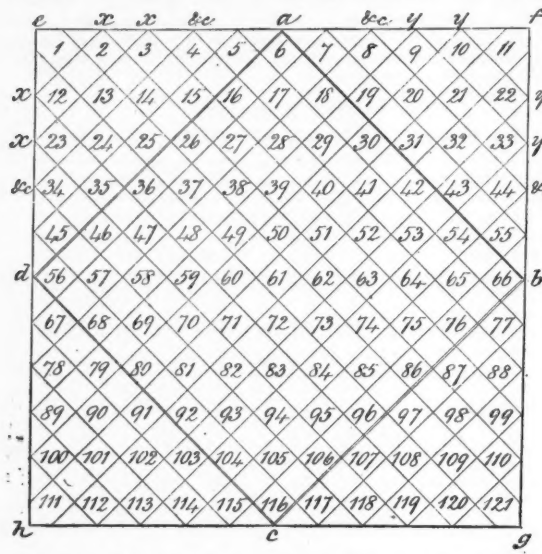
In short, there is scarcely an end to the variety of ways by which 2056 may be made, and to use the constructor's own words, "it is the most magical of all magic squares ever made by any magician."

CLAVIS.

Copied from *The Mirror* of Oct. 28, 1824.

MAGIC SQUARES.

[959]—It may interest some of the readers of KNOWLEDGE to be shown that a "Magic Square" can be made by a very simple mechanical process. Take any square number (with an odd root) of terms in continued arithmetical progression, say 1 to 121, and



write them down in the form of a square, as in the appended diagram. The next step is to inscribe a second square (*a b c d*) in the first. This second square is, of course, just half the size of the first, and will contain one more than one-half of all the terms in the series, *and all in their right places in the proposed square.* Hence it only remains to remove the other terms from the four outside triangles to their respective positions. For convenience draw the diagonals *x x*, *x x*, &c., *y y*, *y y*, &c., and then cut off the four triangles from the inscribed square. Take now one of the triangular pieces, say *a b f*, and place it on the opposite side of the inscribed square, with the side *a b* on *d e*, and the vertex 8 on the centre, that is on the term "61." Dispose of the other three triangular pieces along the corresponding sides; and supposing *transparent* paper to have been used, and the figures to have been accurately arranged, every term will fall into its proper place, thereby completing the "Magic Square." JAMES MACFADZEAN.

A VERY COMPLETE MAGIC SQUARE.

[560].—"G. S." sends you, and you publish under the above title (888, p. 61), a magic square of nine, which he thinks it would be difficult to surpass. I do not clearly understand what "G. S." means when he says with reference to his square that the number 369 is produced "by the angles, whether right, acute, or obtuse, from the corners or the middle from the centre," but I imagine that he refers to some of the ways of making 369 with four pairs of numbers, each making 82, and the central number, 41, added. If this is so, his square possesses only two properties which do not belong to all magic squares; the first, that each of the nine small squares makes 369; and the second, that each number with the number opposite to it makes 82. The latter property gives a choice of four out of forty pairs of numbers which, with 41, make 369. This choice can be made in 91,390 ways; and yet this property is not at all a rare one, or one which makes a magic square particularly curious. It is found in the magic squares made by the very simple rules of Moschopulus and others, and also in squares not magic, made by writing the numbers down in their natural order.

Let me now offer you a magic square of nine, which contains all the properties that I could discover in "G. S.'s" square and some others.

1	44	78	46	62	15	64	26	33
68	21	34	5	39	79	50	57	16
54	58	11	72	22	29	9	40	74
6	37	80	51	55	17	69	19	35
70	23	30	7	41	75	52	59	12
47	63	13	65	27	31	2	45	76
8	42	73	53	60	10	71	24	28
66	25	32	3	43	77	48	61	14
49	56	18	67	20	36	4	38	81

Additional properties of this square:—

1. If one or more rows be transferred from top to bottom, or from one side to the other, or both, the square will still be magic. In other words, all the *broken* diagonals make 369; a broken diagonal being a set of numbers beginning with one in the top, and running diagonally to one side, then entering on the opposite side in the next lower line and running diagonally to the bottom.

2. In any square, whether that given above or one formed by transfer of rows, any nine numbers forming a square make 369.

3. In the small squares into which the above square is divided, each horizontal or vertical row of three numbers makes 123, one-third of 369. A.

[For the present magic squares are done with.—R.P.]

LETTERS RECEIVED AND SHORT ANSWERS.

AN INQUIRER. There is no evidence showing that "the seasons are not what they used to be twenty or thirty years ago;" but when you hear any one say that, you may safely conclude that he (or she) is not what he (or she) used to be twenty or thirty years ago.—G. JINMAN. A happy shot, but made pretty safely.—AN OLD WOMAN. Sorry to hear Mr. Jago mistaken in thinking all Liverpool bread good.—GEOLOGIST. Know of no such work.—F. C. DIXON. Know nothing about blow-pipe, but believe some blow-trumpet articles are appearing in the weekly you mention.—CLASH. Newcomb's explanation of the tides unsound. The usual theory is statically correct, but the true theory is the dynamical one, for sketch of which see Sir E. Beckett's "Astronomy without Mathematics." Do not know where you can get photographs of the sun. Gall's projection not known to me.—JAS. K. THORNETON, GLASGOW. My dear (but atrabilious) sir, you are the solitary survivor (I fancy) of the foolish folk among KNOWLEDGE readers who mistake fun for fury. I thought we had got rid of the last of you. Your weekly twopence would be *far* better bestowed *on Pilul. Antib.* (*Cockl.*).—F. COWLEY. I don't think I promised explanation, only comment. No one can conceive space of four dimensions or more. Would not mind some pretending they can if they would not waste so much time and thought about it. —VEGA. Hitherto I have found no place for poetry, of which a good deal has been sent me. If I make an exception in your case it is because of the bearing of your ideas on my own views, with which (by the way) they are not so inconsistent as many might imagine. The lines shall appear; but the case must not be regarded as a precedent. If readers should approve of the lines, however, the others of which you speak may perhaps find a place. I do not consider myself a judge—for a reason you will understand. —A STARGAZER. How odd that your letter should come next! Your stanzas (as you call them), beginning "The stars so bright! The stars so bright! How beautiful they shine!" &c., would scarcely suit these columns, even if poetry were in general admissible here, which is not the case. Yet the last lines are profoundly touching, and quite merit your notes of admiration:—

With folded hands! Aye, folded hands! and likewise down-bowed head!
I gazed upon the glowing orbs that shone high overhead!
I mused upon those mystic orbs till day came and they fled!

I can understand the folded hands (you should have kept them so) but a down-bowed head hardly suits one who is gazing on stars *overhead*. Your rhyming also is a little shaky; but the same fault may perhaps be found with the following little poem which has

been suggested by your "Stanzas" (note also that your impressive use of italics is followed) :—

The Village Green! the Village Green! How beautiful it is!
I saw a goose upon it, with melancholy phiz!
I saw a goose upon it! and she waddled to and fro!
Yes, to and fro! Aye, to and fro! And likewise fro and to!
She waddled so, I could not tell if she were one or two!

Muse on the mystic meaning in the last line. The goose must have waddled pretty fast, I admit; but the thing is at least as possible as gazing on stars with down-bowed head. The velocity of revolution indicated in the following lines is far greater :—

There was a man from Yankee land
Who round a walnut tree,
Did run so fast—that lissome man—
His own back he could see!

—Personne. Pardon me, no one here has denied that compositors do good and useful work in pointing matter not properly punctuated by the author. Sir E. Beckett expressly called attention to the point, in his remarks on the comma. There is scarcely a writer who does not give the compositor work of this kind. If calling attention to the annoyances which arise from point-peppering means want of due recognition of compositors' care in pointing your plea is good enough: but then it does not. Your friend "a compositor of thirty years' experience" calls attention to certain inconsistencies in punctuation which he has noted in Knowledge. They are chiefly "printer's errors" overlooked by author in proof correction; or (in the case of two articles) overlooked by "reader," for these articles were not seen in proof by the author. I might as reasonably insert a letter calling attention to every case of imperfect type, inverted letters, p for p, d for d, and so forth. With regard to the position of) outside or inside "period," comma, or ?, I leave that to compositors, not deeming the matter worth contesting. But what your friend thinks a redundancy—the use of both a comma and a dash,—is no redundancy at all: his remarks on that point show that he has no idea of the real use of the dash. A comma, a dash, and a comma *plus* a dash, mean three different things. When you throw in words not distinctly parenthetical, where if the words were omitted no comma would come in, you use the dash only; but if a comma would come in, the introduction of the dashed in words does not justify the omission of the comma. When but one dash is used, as where words are thrown in at the end of a sentence, one should use a dash only or a comma and a dash, according to the degree in which one may wish the reader's mind to pause, so to speak, before it considers the added idea. One may even find it well, in certain cases, to use a semicolon and a dash. The colon and dash have a special and well-known use. In passing, I may note that in some cases a paragraph may conveniently be closed with a colon instead of a period. I could point to many cases in which for want of this or some other way of indicating connection between two successive paragraphs (rightly put as separate paragraphs, however) the opening sentences of the second are perplexing: really carrying on the idea dealt with in the first paragraph, they are read as if introducing a new idea. See especially De Morgan's "Budget of Paradoxes" for cases in point. Lastly, if your friend cannot see a good reason why in the sentence "It is singular, too, how along with meanness," &c. a comma should be set each side of the too, whereas in the sentence "This too may sometimes be seen &c." no commas are wanted, all I can say is that I can very well understand how it happens that he remains a compositor after so many years' experience.—F. J. F. Have not tried the system.—Aqua Pura. Do not know which is the best filter for domestic use.—W. E. Crowther. Thoroughly agree that hygiene should be made a subject of special instruction; but cannot find room even for an abstract of so long a letter.—R. H. Riches. Thanks. Subject suitable, but now no space.—W. B. Thanks. Yet I think the Rigmarole inventor scarcely meant *that*. I have forgotten whether his letter came under my attention or not. Think not.—H. Ossipoff. If the matter were really one for discussion and the person who has adopted that name would keep to discussion, it might be done. But as a matter of fact, that person knows perfectly well that his pretended system is baseless. There is also not a single argument in his book which should perplex you. Here is one simple proof that the whole system is absurd. Were it true, the sun, as you can see from his own illustrations, would vary enormously in apparent size during the day. Your own eyes should show you then that the theory is nonsense,—very well as a catchpenny, but not really held by the writer and lecturer who defends it. The other person, poor fellow, is not responsible: he really thinks the theory true: imagine what sort of a mind his must be!—E. W. Barton. Thanks for very amusing extract from *Manchester Courier*: well hit, *M. C.!*—W. G. Woollcombe. Perhaps some reader can name good and reliable books in French and German, on Geometry of Two Dimensions, and Higher Plane Curves.—W. Butler. Alas, have never seen, nor therefore used, that particular telescope.—Uncertain. Let us try to understand each other. You raised the question—What is natural and what is supernatural? I admitted the perplexing nature of such an inquiry, and later expressed the belief that so metaphysical a subject would not interest readers and ought not to occupy space here. You find in this evidence of a wish to burke freedom of speech. Now I think you must know very well that if I have not inserted your remarks on a very difficult and not particularly interesting question it is not because they are personally distasteful to me. I have to omit nine-tenths at least (I expect 99-100ths would be nearer the mark) of what is sent for insertion in the Correspondence columns; and quite a large proportion of what is so omitted is full of interest for me, and often agrees pretty closely with my own views. I agree with a good deal that you say. I am not very clear you may not be right and I wrong where I differ from you. I may be wrong even in thinking most of our readers would not be interested by an inquiry dealing with so perplexing, so shifty a matter as the true place of the defining line between what is natural and what would be supernatural. I can only act to the best of my judgment. But omitting your communication involves no interference with your freedom of speech. If many are interested in the matter you can readily find your audience. As to the question you have raised—there are certain properties of matter and certain laws according to which these properties act under various conditions; some of these properties and laws have been determined, many have not, but the properties and laws are there all the same: I take it that the supernatural is in ordinary thought distinguished from the natural in this, that while everything which happens consistently (whether provably so or not) with the actual properties and laws of matter, is natural, any event not consistent with these properties or laws is supernatural. An event may seem supernatural which is really natural. A Labouchere will regard as a miracle what a Carpenter would regard as consistent with the laws, known or unknown, of matter. But an event would be really supernatural, if for its occurrence, the properties and laws of matter had to be temporarily changed or held in suspense.—W. H. Collins. (1) I agree with you that 288 is a value of x satisfying the equation $\sqrt{x+1}+\sqrt{2x}=7$: there is no occasion to write $-\sqrt{x+1}$; for -17 is a value of $\sqrt{289}$. (2.) Prof. Cayley meant, I suppose, that Mr. Glaisher had completed the determination of the factors of the missing three millions out of the first nine million numbers.—H. G. A. Brown. There is certainly no fault to be found with your readiness as a writer, and your freedom of diction. But the article is rather long for what it aims to establish (in which, by the way, I quite agree with you), that in making room for science in education we ought not to exclude literature or become too scientific. As that freed fellow says in the Andria, the rule in such matters should be *Ne quid nimis*. Only he said it rather more laconically than your article.

Our Chess Column.

By Mephisto.

SOLUTION.

Problem No. 100, p. 208.

1. B to B2 (disc ch)	1. Q takes Q
2. Kt to Q7 (ch)	2. Q takes Kt
3. Kt to B7 (ch)	3. Q takes Kt
4. R to Kt5 (ch)	4. Q to Q4
5. P to Q4 (ch)	5. P takes P (en p ch) mate

CHESS playing is practised in different ways. There are persons who find their enjoyment in playing what are usually termed skittling games. To a casual observer it may seem that the mere moving of the pieces constitutes sufficient amusement for them. To these frivolous devotees of the game, Chess playing serves merely as a mechanical pastime. Such players may, however, be quite as fond of the game as the more serious class, who love to dive into the depths and intricacies of Chess, and who find their intellectual enjoyment increase in proportion to the difficulties of the game. Chess then becomes an intense mental exercise, a struggle of mind against mind.

We have a well founded belief that the struggle is not decided

purely by the relative chess skill of the players. We believe that *a strange influence of mind over mind is also exercised on some rare occasions*, and that this influence materially affects the result of a game.

A common kind of influence has frequently been experienced by many Chess players. Who has not met an opponent whose peculiar play or personality influenced the result of a game played with him? If you happen to meet an opponent who is all smiles and compliments, and of such extreme modesty as to hold up your own play as being beyond praise, while he evinces a corresponding contempt for his own weakness, then be very careful lest you be beguiled into believing him and taking it easy, for you are sure to lose. Another person, who may be a dull and cautious player, will tire you out and thus win a proportion of games quite beyond his Chess strength. Again, there is something irritating in the style of some players, which prevents you doing justice to yourself. We were much amused on one occasion when one day playing both a father and his son, we found the son to be a better player than his father. Our surprise was, therefore, great on learning that the son received the odds of a Knight from his father, and that the latter often won. In all these cases the influence admits of a natural explanation. We are conscious that our senses are affected, as in the above instances, by being either beguiled, wearied, elated by a firm belief in our own superiority, &c. This we will call a conscious or natural influence.

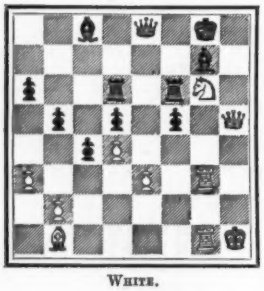
There is, however, another and more powerful influence exercised upon us on rare occasions, which apparently does not operate through the medium of our senses, but in an unconscious manner, which as yet admits of no natural explanation.

This supernatural,* or extraordinary influence of one mind over the other might perhaps be traced in the match between Steinitz and Blackburne. The latter, one of the foremost players of our time, and who has subsequently proved himself nearly the equal of his opponent, as is well known lost seven games without winning or drawing any, in spite of having had several won games in hand. Here we are confronted with a problem which admits of no other plausible solution but that the seriousness and intensity of match play had called forth some influencing power which hopelessly conquered an opponent, who, in the less serious encounters of tournament play, was quite capable of holding his own against the same adversary.

From our own experience we have reason to believe that in some positions an intense desire or will that your opponent may not play a certain move will sometimes unexpectedly be rewarded with success. Only on this theory can we explain the weakness of some players at a critical moment, who will deliberately make the only possible move in a game which avoids winning. The following examples, from actual play, will better illustrate our meaning.

The result of a game recently played was of the greatest importance to Black, who had a bad game, and strained every nerve to avoid the impending defeat. In the annexed position Black clearly saw that he was lost. White likewise perceived the winning line of play, which was as follows :—

Black.



White.

Kt to K7 (ch)	Q takes Kt (best)
R takes B (ch)	Q takes R
Q to K8 (ch)	K to R2 (best)
R takes Q (ch)	K takes R

Q takes B, and White has a winning advantage.

In spite of clearly seeing this, some strange influence caused White to play Kt to B4, which enabled his opponent to win his Queen by R to R3. White of course perceived that he had made a blunder at the very point of winning. The game then continued as follows :—

R takes B (ch)	K to R sq. (best)

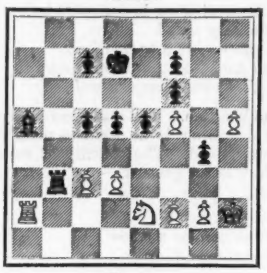
R (Kt7) to Kt5, with the intention of playing R (Kt sq.) to Kt3, followed by R to R3, which would win (if Black played R takes Q (ch), White would ultimately remain with a piece ahead).

	K to R2 (best)
R to Kt7 (ch)	K to R sq.
R to Kt5	K to R2

Black offered a draw. White, having missed an obvious win—making a blunder instead—should have been well satisfied with the chance of drawing, and not have proceeded with a hopeless game. Incredible as it may seem, White refused the draw—why we cannot tell—and lost.

* Anything being beyond the known laws of nature.

Black.



White.

The following is also a remarkable instance how a game can be lost. In this position of an important game, Black found himself with a hopelessly lost game. If the Black B retires to Kt3, the White KRP will go on to Queen; or if B takes BP, White will likewise play P to R6, compelling R to Kt sq., and thus winning the B. Applying himself intensely to the position, Black made a desperate effort and succeeded in saving a game in which the chances were at least ten to one against him. Black played :—

	P to K5
P takes P (R takes B would win)	
	P to Q5
P takes P (again missing R takes B)	
	B to K8
Kt to B sq. (weak)	P to Kt6 (ch)
P takes P	B takes P (ch)
K to R3	R to K6
R to K2	B to B5 (ch)
R takes R	B takes R

Now in this position, the game which Black may be said to have pulled out of the fire, ought to have been drawn by correct play, but, as in the foregoing example, it was not to be drawn, for apparently *Black had made up his mind to win.* White played P takes P, upon which, of course, followed B takes Kt, and White resigned.

We do not wish to be misunderstood as saying that one man has it in his power to win a game by the mere exertion of his will. We merely have cited a few out of many remarkable examples how in extreme cases defeat has been turned into victory, and where play on one side has been so obviously and persistently bad as to exclude an explanation of momentary weakness or oversight. We therefore feel justified in suggesting as a plausible cause of some of these surprising results the influence of mind over mind, or the power of will. But this strange influence is as yet an unsolved mystery to the wisest, and we do not hope nor attempt to convince where better men have gained naught but sneers and disbelief.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Stettin.—Solution incorrect.

W. Furnival.—Solutions correct. Please use English notation.

Alpha.—1. Article "How to Construct a Problem," was published in No. 52, of October 1882; you can obtain it by applying to the publishers. 2. Miss Beechey's Chess.

Blossoms.—Solution incorrect.

Squire.—In Problem 101, If 1. B takes P, P takes Kt, and there is no mate.

Problems received with thanks from Berrow and E. N. Frankenstein.

C. Bennett.—See reply to Squire.

E. F. B.—If R to B2 and B6, then the KP takes R, and there is no mate.

No. 101.—By R. Champ, Berrow, Squire. The Arabian by W.

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